THE *LONGITUDE* AT SEA.

Price Six-pence.

Cup. 406. g. 45.

BRITISH MUSEUM
30 OCT 70

THE
LONGITUDE
AT
SEA,

Not to be found by *Firing Guns*, nor by the Moſt Curious *Spring-Clocks* or *Watches*.

BUT

The only True Method for Diſcovering that Valuable *Secret* by the *Sun*, *Moon* or *Stars*, and an *Exact Time-keeper*, with ſuch Neceſſary Improvements, as have not yet been Deſcrib'd by any other Perſon; and (with reſpect to the Term of any Ordinary Voyage) may properly be call'd *a Perpetual Motion*.

Now Humbly PROPOSED,
To the Conſideration of the Publick,
By *CASE BILLINGSLEY*.

LONDON: Printed for RICHARD MOUNT,
and Company, on *Tower-Hill*, and JOHN
MORPHEW, near *Stationers-Hall*. 1714.

BRITISH MUSEUM
30 OCT 70

The Dedication.

TO *the Firſt Commiſſioner of the* Admiralty.

The Speaker of the Hon^{ble} HOUSE OF COMMONS.

The Firſt Commiſſioner of the Navy.

The Firſt Commiſſioner of Trade.

The Admirals of the Red, White, and Blew Squadrons.

The Maſter of the Trinity-Houſe.

The Preſident of the Royal Society.

The Royal Aſtronomer *of* Greenwich.

The Savilian, Lucaſian *and* Plumian *Profeſſors of the* Mathematicks *in* Oxford *and* Cambridge.

The Right Honourable Thomas *Earl of* Pembroke *and* Montgomery.

Philip *Lord Biſhop of* Hereford.

George *Lord Biſhop of* Briſtol.
Thomas *Lord* Trevor.
The Honourable Sir Thomas Hanmer,
Bar^t. Speaker of the Honourable
HOUSE OF COMMONS.
The Honourable Francis Robarts, *Eſq*;
James Stanhope, *Eſq*;
William Clayton, *Eſq*; *and*
William Lowndes, *Eſq*;

Conſtituted by the Parliament of GREAT-BRITAIN, *Commiſſioners for the Diſcovery of the* **Longitude at Sea**; *and for Examining, Trying and Judging of all Propoſals, Experiments and Improvements relating to* the ſame.

This Method for that Diſcovery is (with much Humility) Dedicated and Submitted by the AUTHOR.

PREAM-

PREAMBLE *of the* Act *for providing a Publick Reward for ſuch Perſon or Perſons as ſhall diſcover the* Longitude at Sea.

" WHEREAS it is well known
" by all that are acquainted
" with the Art of *Navigation*, That
" nothing is ſo much wanted and
" deſired at Sea, as the Diſcovery of
" the *Longitude*, for the Safety and
" Quickneſs of Voyages, the Preſer-
" vation of Ships, and the Lives of
" Men: And whereas, in the Judg-
" ment of able Mathematicians and
" Navigators, ſeveral Methods have
" already been diſcovered, true in
" Theory, tho' very difficult in Pra-
" ctice, ſome of which (there is rea-
" ſon to expect) may be capable of
" Improvement; ſome already Diſ-
" covered

“ covered may be propoſed to the
“ Publick, and others may be invented
“ hereafter. And whereas ſuch a
“ Diſcovery would be of particular
“ Advantage to the Trade of *Great-*
“ *Britain*, and very much for the
“ Honour of this Kingdom; but
“ beſides the great Difficulty of the
“ Thing it ſelf, partly for the want
“ of ſome *Publick Reward* to be
“ Settled as an Encouragement for
“ ſo uſeful and beneficial a Work,
“ and partly *for want of Money for*
“ *Tryals and Experiments neceſſary*
“ *thereunto*, no ſuch Inventions or
“ Propoſals, hitherto made, have
“ been brought to Perfection.

“ **Be it therefore Enacted**, &c.

THE LONGITUDE AT SEA; &c.

I Was in hopes ſome Learned Gentlemen had at laſt hit upon that which would have been very acceptable to the World, with reſpect to **Longitude,** but upon peruſing their Schemes, I found them wholly Impracticable, and full of Uncertainties and Hazards.

This put me *afreſh* upon Conſidering and Improving a Notion I have entertain'd many Years, *viz.* That if ever **Longitude** is to be found out, it muſt be by the Aſſiſtance of **Heaven** and **Earth**, I mean by the **Sun**, **Moon** or **Stars**, and a **true Time-keeper.**

I am certain it will be granted by all that underſtand *Aſtronomy* and *Navigation*, and have conſider'd the ſeveral Methods that have been Propos'd to Diſcover this Great and (when found) moſt Uſeful Part of the Mathematicks; That if Time can be kept exactly at Sea, the Buſineſs is done.

And indeed it ſeems very eaſy to prove, that no other Method (yet Propos'd) can ever anſwer this End; nor muſt we look for any, unleſs we would flatter our ſelves, that one Time or other, we ſhall find a *Needle* that ſhall point it to us; But he that conſiders what Longitude is, has no reaſon to expect ſuch a Miracle.

* 'Tis true the *Loadſtone* aſſiſts a ſmall Needle to ſhew every *Point of the Compaſs*, where-ever you are (when you have allow'd for the *variation*) but tho' this might at Firſt be eſteem'd a Miracle, becauſe the Uſe of it was not before known to us; yet I doubt not but that *Surprizing Stone* had the ſame Virtue *in itſelf*, ever ſince the World be-

---

* *By the Attraction and Repulſion of the Loadſtone (in its oppoſite Poles) upon that vaſt Quantity of Iron that is in the Bowels of the Earth, it ſeems not altogether improbable, that this ponderous Globe of the Earth, may be kept in its place. I know, he that made it of Nothing, can Support it in the Air by His immediate Power; but His Wiſdom ſhines no leſs in working by Means (of His own providing) than if he wrought without them: He could Support us without Food, but He has not thought fit ſo to do. I do not poſſitively affirm, That the Earth is kept together, and upheld by the Virtue of the Magnet; but this I am ſure of, That the Trade of the Univerſe could never have been upheld as it is, if the Virtue of that Stone, had remain'd a Secret to this Day; and no doubt, every help to Navigation, will be found a Benefit to Trade, as I hope Longitude will e're long be.*

gan; and there may be ſome rational Account given of it, *viz.* It is highly probable, the Wiſe Creator of the World has placed in (at leaſt) *One of the Poles of the Earth*, a vaſt Quantity of this *Magnetick Stone*; which may always by its *attractive Effluvia*, draw towards its ſelf a Needle finely poized and touched therewith: But if a Needle ſhould be found out, That (touch'd by a New and Wonderful Magnet) ſhould point out the Degrees of Longitude under the Equator; thoſe Degrees muſt alſo (by Virtue of this New Loadſtone) be contracted ſtill leſs and leſs, the nearer I Sail to either of the Poles, or elſe it would be of little uſe to me.

And tho' even this is not only poſſible, but very eaſy to Him *that can do all Things*; yet we may with as much reaſon hope e're long to ſee the *Heavens drawn with curious Black Meridians*

Meridians through every Tenth Degree of the Equator, which ſhall meet in the Poles, as to find a Stone that ſhall help us to the **Longitude**. It ſeems therefore highly reaſonable, That while we believe it poſſible to find out this *Secret* (with near the ſame certainty that we have **Latitude**) we ſhould not be aiming at Methods utterly impracticable, but ſtudy to improve the moſt likely and obvious Things that are within our reach, tho' there may appear to be ſome great Difficulties attending them.

He that made the Viſible Heavens and all the Hoſts of them, for the Service of Man, has ſhewn not only his Power and Wiſdom, but his Goodneſs too, not only in giving them Motion, Light, Heat, and a Power ſweetly to influence the lower Parts of his Creation; But their Surpriſing **Exact Motions**, ſeem to be principally intended to let us know (with ſufficient certainty) whereabouts we are, both with reſpect to **Time** and **Place**; and it is not to be overlook'd (that ſince the *exact Motion* of thoſe *Great Luminaries* alone, (without proper Machines or Inſtruments to make our Obſervations) would not help us to know where we are. The Great Governor of the World has pointed out to Man *a Motion* within his own Reach and Management, that (with reſpect to our niceſt Obſervation) may be ſaid to Correct even the Motion of the **Sun** itſelf. Now it is by the help of theſe Motions, that I hope to know my **Longitude**; and if it cannot be done this way, I am ſatisfied it will never be found out to any Degree of certainty while the World endures, unleſs ſomething with a *Magnetick force*, ſhould be

Diſcovered much more Wonderful than the common *Loadſtone.*

Tho' it appears very difficult, yet I am certain, no **Mathematician** will affirm, that it is impoſſible to keep Time as exactly upon the Sea (even in Bad Weather) as upon the Land. A Perſon that knows not how it is done, nor never heard of any ſuch Thing, would think it impoſſible for him to rub a bit of Paper between his Fingers, and make it inſtantly Flame, ſo as that (by it) he may Light a Candle, as well as any other way whatever; or to hang a Quantity of common Water in the Air, without any Thing under it to Support it; to make little Stones move upon the Ground like Living Creatures, without any Hand touching them; to Preſerve Fire in Water many Years; to make Glaſs Images of Men and Women, immediately riſe to the Top, fall to the

Bottom, or remain in any intermediate ſpace of a Glaſs of common Water, without the Aſſiſtance of Hairs, Threads or Wires; Or, by mixing Two Cold Liquors to produce a Heat, much more intenſe than can (ſo ſoon) be done by the Hotteſt Fire.

Theſe, and abundance of ſuch Things as ſurprizing, are not Quibbles, and yet are very eaſily done, and that without the mean Helps of Legerdemain, or the baſe Arts of Magick.

And why may not a curious long *Pendulum-Clock* (notwithſtanding the *Motion of the Ship* and the *Alteration of the Air*) be preſerved from any conſiderable Irregularilties *at Sea* as well as *a-Shore*. I know it will be ſaid, That a common *Pendulum-Clock* has been hung at *Sea*, but the Motion of the Ship in bad Weather, hinder'd its regular Going: To this I anſwer, That tho' a *Pendulum* is to be the Governing Principle of the *Movement* I propoſe, yet there muſt be as much Difference between the Contrivance, the Form, the Placing, and the whole Oeconomy thereof, and that of a common Clock, as there is between a *Houſe* and a *Ship*. The chief Difficulty is to obtain a *Steady even Motion* in the midſt of an *irregular one*; and if I can demonſtrate that that is to be done in Things that ſeem as unlikely as this, I hope it will be reckoned more than probable, that I can ſo manage a *Pendulum*, that the Irregular Motion of the Ship ſhall do it very little or no Damage.

I know it is propoſed to obtain this exact Motion by a *Spring-Clock* or *Watch*; if that could do, it would ake up leſs Room, and be leſs liable o Injuries from the Motion of the Sea, than a *Pendulum-Clock*: But it s a ſure Maxim (let it be apply'd to what it will) " That a Thing cannot

“ communicate that to another
“ which it hath not in it ſelf.

A Pendulum is a certain and exact Motion, which you may prove thus; Take Three or Four Bullets of the ſame Weight, and hang them on Pins with Threads all of the ſame Length, and ſet them a moving, let ſome of them move as ſlow, others as faſt as you pleaſe, or (which is the ſame thing) let ſome of them have a large, others a very little Swing; you will find they ſhall all make the ſame Number of *Vibrations* in a Minute, or any longer Time. Now as there is this *Certainty* in theſe *Pendulums*, they do (by good Management) *communicate* the ſame *Regularity* to a *well-made Clock*; but *the Ballance-Spring* and the Oyl of a *Watch* is ſo alter'd by Heat and Cold, that if a *Fuſe* be never ſo well adjuſted to anſwer the Strength and Weakneſs of the Main-Spriug, the Stiffneſs and Plyableneſs of the *Ballance-Spring* (which is the chief

Governor of its Motion) makes it go much faſter or ſlower than it ſhould, according to the Alteration of the Air from Heat to Cold, and from Cold to Heat again; which is ſo uncertain every Night and Day, that it is impoſſible, by any Tables, to make exact Allowances for it: And Four Minutes loſt or gain'd (you know not which) makes an Error in your **Longitude**, Three-ſcore (and it may be One hundred and twenty) Geographical Miles, that is to ſay, If you ſuppoſe your Watch too faſt Four Minutes, when it is really ſo much too ſlow.

The Uſefulneſs of ſuch a Machine as I propoſe, will compenſate all the Trouble and Charge, when brought to Perfection; and if I can do that (as I doubt not I can) I hope it will be own'd, That I have found out a very eaſy, ſure, and obvious Way of knowing my **Longitude**, which I am ready to try at Sea, upon the Encouragement offer'd by our Parliament.

Though many of my ſpare Hours have been ſpent in this uſeful Study for more than Twenty Years paſt, yet I freely own, That the Encouragement now offer'd to any One that ſhould find out **Longitude**, and the Unlikelineſs of the Methods propos'd by others, put me *afreſh* upon contriving Ways to obviate all the Difficulties that ſeem to attend that which I ever thought muſt find it out; and I am ſatisfy'd I have hit upon the true and only Methods of doing it.

But I am to ſhew, That the Ways propoſed by ſome, are neither Practicable nor Safe; if they were, it would be needleſs to offer at any Thing elſe.

1*ſt*, Thoſe Gentlemen that propoſe to do it by Hulls of Ships and Guns, ſeem to own, That that Method would be ſo very Coſtly, that all

Trading-Nations muſt joyn to defray the Charge: And if all the World could be prevail'd with to agree to that, I doubt it would be a difficult Matter to collect every one's Quota, (eſpecially in a Time of War) or to chaſtiſe a Potent Enemy, if by the help of theſe Hulls of Ships, and by firing Guns contrary to the ſtanding Rules agreed on, he ſhould deceive us to the Ruin of our whole Fleet.

2*d*, I humbly conceive there muſt be more Hulls of Ships laid in the Sea than they imagine; for how far ſoever you may hear a Gun in calm Weather, or by the help of a fair Wind, it is well known, that a contrary Wind ſhall hinder you from hearing, even Great Guns, tho' but Twelve Miles off.

3*d*, It is impoſſible to keep theſe Hulls of Ships in the Places you fix them at Sea; For, if you had Cables long enough to reach good Ground, the Swell of the Seas (which run

Mountains high) would ſoon tear all to Pieces; and if you hope to ride only by Weights below the Currents, thoſe Weights muſt be ſo great as that the Ship (notwithſtanding her being toſs'd prodigiouſly) cannot move them; and then they muſt unavoidably break your Cables, or ſink your Ship.

4th, If Hulls of Ships could be fix'd, as propos'd, It would be a hard Matter to find Seamen that would be confin'd to them, or that would expoſe themſelves to Starving, and to the Mercy of perfidious and cruel Enemies, Pirates, *&c.* beſides the Danger of being drove from their Stations, and lying as Wrecks in the Sea, I fear was not duly conſidered.

5th, If ſuch Seamen could be found, and they had ſuch Inſtruments as to know Midnight exactly in all Weathers (tho' I do not remember any Proviſion for them of that Nature) and ſuppoſing the Watch were always ſo wakeful and ſober, as then to fire a Gun, it will be impoſſible for a Ship at a Diſtance (that has neither ſeen nor heard any of theſe Guns for many Days) upon hearing a Gun to know which of the Hulls it was that fired it, unleſs they ſpeak with her, and ask the Queſtion, and demand what Degree of *Latitude* and *Longitude* they are in; and if they have been drove by *Tempeſtuous Weather*, the Hulls would be glad to know where they are themſelves, and how to avoid the *Rocks* they are deſign'd to keep others from *ſplitting* upon.

6th, If Men were always Sober, Honeſt and Wakeful, and Gunpowder ſo proportion'd, both as to Strength and Quantity, as to throw a Shell at Sea exactly ſo many Feet right up into the Air, as is propos'd, it would be almoſt as hard to find my Diſtance from that Hull in the Night, as to find **Longitude** when I have got my Diſtance: When I have found my Diſtance, how ſhall I know which of the Hulls it was that fired, and if I know not that, how ſhall I know what Degrees of *Longitude* and *Latitude* ſhe is in, or whether ſhe is not removed from her Station by Extremity of Weather, as aforeſaid.

What I have humbly to offer to the Publick will be no great Charge, when once the Method is fix'd and Molds prepar'd; It is in ſhort this, *viz.* I would provide each *Ship* with an exact *Time-keeper*, and *thereby* obſerving the Difference of Time between the *Sun* or *Stars* coming upon the *Meridian* of *London* (or any other noted Place) and their coming upon the *Meridian* where I am: This Time converted into Degrees and Minutes tells me the **Longitude**, or how many Degrees I am Eaſt or Weſt from *London*, or any other Place.

The *Time-keeper* I propoſe is to be regulated by a *Long-Pendulum*; the whole *Movement* ſhall be perfectly kept free from Damps, and ſecured from all extraneous Air: It may go above a Year without any Perſons touching it, ſhall move in a proper, tho' not in a common Body, and in ſuch a Part of the Ship, and ſuch a poſition as to be always Perpendicular, tho' the Ship toſſes or rowls never ſo much; the Motion of the Sea ſhall not alter it, ſo as to occaſion any conſiderable Error; and the *Pendulum-Rod* ſhall be ſecured from lengthning by Heat, or ſhortning by Cold. The whole Charge of which, for a great Ship, and all that muſt ſecure it from Injuries by the Motion of the Ship, Wet, Heat, Air, *&c.* will not be great; and (barring Accidents) will laſt above Thirty Years.

Thoſe that before-hand are reſolved not to ſeem pleas'd with any thing except it be their own Invention (for want of ſomething elſe to ſay) will be ready to object, That if I have found out ſuch Ways as will effectually obviate every Inconvenience that Motion and the Alteration of Air may occaſion to a *Pendulum-Time-keeper*; Yet upon Tryal it will not be found to agree with the **Longitude** of Places, as they are laid down upon the beſt *Maps* and *Charts* we have.

I readily own, That if my *Time-keeper* be true, the **Longitude** I find, will differ from that given by the beſt *Maps* and *Charts*. The Reaſon is obvious, *viz.* There having been yet no exact Method of knowing the **Longitude** at Sea, moſt Places on our beſt **Globes**, **Maps and Charts**, (with reſpect to their **Longitude**) are laid down by Gueſs; but when a true **Time-keeper** at Sea is found, all thoſe Errours in our **Globes and Charts** will be eaſily rectified: The way to know whether my **Time-keeper** be true or not, is to obſerve the **Longitude** by the **Movement**, then Sail *Eaſt* or *Weſt*, as far as you pleaſe, and when you return to the ſame Place, obſerve whether your **Longitude** be the ſame, that it was when you took your Departure; If ſo, your Time is truly kept.

As I ſaid before, the Contrivance of my **Movement**, differs as much from a common Clock, as a *Ship* differs from a *Houſe*; the Baſis of it is a long **Pendulum**; the **Movement** ſhall ſhew the Hours, Minutes and Seconds, freed from every thing that may Clog it, or interrupt its *regular Motion*, for near a Year and a Quarter, *without Winding up*; the whole *Engine* about Four Foot and a Half long: I doubt not, I have hit upon ſuch Ways to ſecure its exact Motion, as that I ſhall be able to ſhew the **Longitude** thereby at Sea, **to Half a Degree, or Thirty Geographical Miles**, which is to the greateſt nicety expected by the Parliament of *Great-Britain.*

And whenever required, I am ready to Demonſtrate to the Commiſſioners for the Diſcovery of the **Longitude**; that a Regular and **Steady Motion** may be preſerv'd in the midſt of a very **uncertain and uneven one**; And that I can provide againſt all the Difficulties that (at firſt View) ſeem to lye in the Way of the Method Propoſed by

Their Moſt Humble and

Moſt Obedient Servant,

From my Houſe near
the *Hermitage, St. John's-Wapping,* 26
July, 1714.

Caſe Billingsley.

BRITISH MUSEUM 30 OCT 70